

Measurement and Transducers

Time 3 Hr.

Full Marks: 100

1. Answer any three questions

3×5

- Explain the working of attraction type moving iron instruments with a neat diagram. How are the controlling and deflecting torques produced in these instruments?
- How is the current range of a PMMC instrument extended with the help of shunts? Describe a method of reducing errors due to temperature changes in the shunt connected instruments.
- Explain how the following adjustments are made in energy meters
(i) lag adjustment and (ii) creep
- Derive the expression for torque of an electro-dynamometer type wattmeter. Explain why it is necessary to make the potential coil circuit purely resistive.

2. Answer any two questions

2×8

- Draw the circuit of a Kelvin's Double Bridge used for measurement of low resistance. Derive the condition for balance.
- Draw the equivalent circuit and phasor diagram of a potential transformer. Derive the expression for ratio and phase angle error.
- How does a low voltage Schering bridge work? Derive the expression for the capacitance and dissipation factor. Also draw the phasor diagram of the bridge under balanced operating condition.
- Explain the working of a Megger with the help of a neat diagram.

3. Answer any five questions

5×8

- A 500/100 V Potential transformer has primary and secondary winding resistances of 48Ω and 0.45Ω. The primary winding reactance is 35 Ω and secondary winding reactance is negligible. No load primary current 0.1 A at 0.6 pf. Calculate the phase angle error at no load and the burden at unity pf at which the phase angle is zero.
- A moving coil instrument has resistance of 6.5 ohm between terminals..the full scale deflection with a current of 10 mA. This instrument is to be used with a manganin shunt to extend its range to 50 A. Calculate the error caused by 10°C rise in temperature when;
 - The internal resistance is 5 ohm due to copper coil only
 - A 5 ohm manganin swamping resistance is used in series with the copper coil of 1ohm resistance.

The temperature co-efficient of copper is 0.004/°C and that of the manganin 0.00015/°C.
- The inductance of a moving iron ammeter is given by: $L = (0.004 + C\theta)^2$ where θ is the deflection from zero position in degrees. The angular deflections of the instrument corresponding to 1 A and 2 A are respectively 90° and 120° respectively. Find the value of C.
- Four arms of a Maxwell's capacitance bridge at balance are: arm ab, an unknown inductance L_x , having an inherent resistance R_x ; arm bc, a non-inductive resistance of 1000Ω; arm cd, a capacitor of 0.5 μF in parallel with a resistance of 1000Ω; arm da, a resistance of 1000Ω. Derive the equation for the balance of the bridge and determine the value of R_x and L_x . Draw the phasor diagram of the bridge under balanced condition.
- The ratio arms of a Kelvin double bridge are 100Ω each. The galvanometer has an internal resistance of 500Ω and current sensitivity of 200mm/μA. The unknown resistance is 0.1002Ω and the standard resistance is set at 0.1000Ω. A dc current of 10A is passed through the standard and the unknown resistance from a 2.5 V battery in series with a rheostat. Calculate the deflection of the galvanometer. Neglect the resistance of the link.
- The coil of a moving coil voltmeter is 50mm×40 mm wide and has 100 turns wound on it. The control spring exerts a torque of 0.2×10^{-3} Nm when deflection is 50 divisions on the scale. If the flux density

of the magnetic field is 1 wb/m^2 , estimate the resistance that must be put in series with the coil to give 1 volt per division. Resistance of the voltmeter is 10,000 ohm

4. Answer any three questions 3×8
- (a) Describe the methods measurement of pressure using different capacitive, piezoelectric transducers.
 - (b) Explain the thermoelectric phenomena and show how a temperature measuring system can built using this. Discuss thermoelectric laws with proper illustrations.
 - (c) What are thermistors? Discuss the resistance-temperature characteristics of thermistors and the method of measurement of temperature with the use of thermistors.
 - (d) Define the following transducer characteristics: Accuracy, Calibration, Reproducibility and Resolution.
 - (e) Describe the working and the construction of resistance thermometers. Mention the materials used for RTDs and draw the characteristics.
5. Answer any one: 1×5
- (a) Explain the working principle of Hall-effect transducers. What is Hall-voltage? State the factors on which Hall-coefficient depends.
 - (b) Discuss with a neat diagram the application of the thermocouple for measurement of flame temperature.